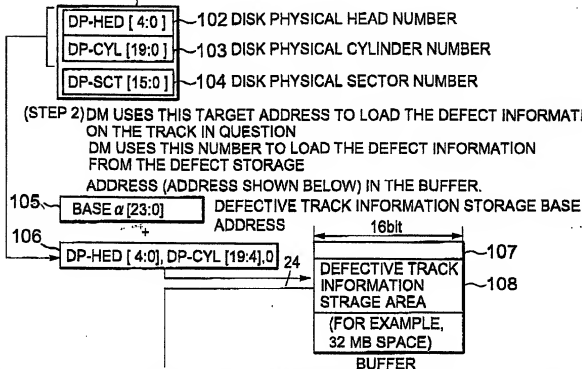


FIG. 1

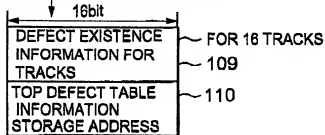
## METHOD OF ACCESSING DEFECT INFORMATION

(STEP 1) MPU DESIGNATES A TARGET ADDRESS TO DF.

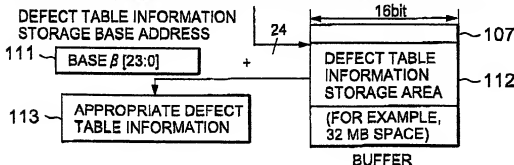
101 DISK PHYSICAL CHS NUMBER



(STEP 3) TOP STORAGE ADDRESS AT WHICH A DEFECT EXISTS IS OBTAINED FROM THE DEFECT INFORMATION LOADED.



(STEP 4) TOP STORAGE ADDRESS AT WHICH DEFECT TABLE INFORMATION EXISTS IS OBTAINED FROM THE DEFECT INFORMATION LOADED.



### FORMAT OF DEFECTIVE TRACK INFORMATION STORAGE AREA (TYPE 1)

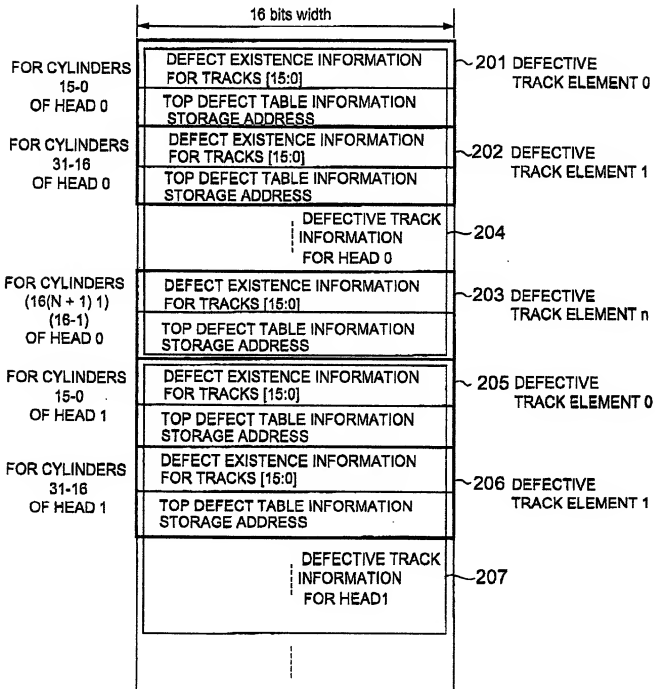
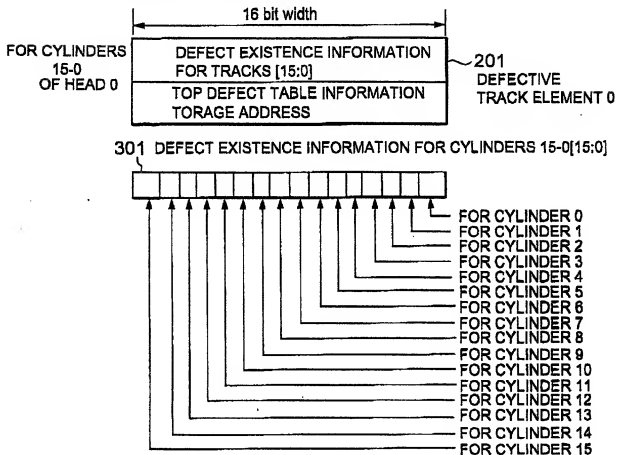


FIG.3

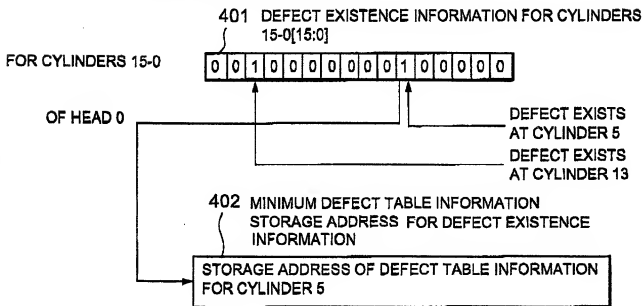
EXAMPLE OF FORMAT OF DEFECTIVE ELEMENT INFORMATION  
FOR TRACKS (TYPE 1)



1000569-121001

FIG.4

EXAMPLE OF FORMAT OF DEFECTIVE TABLE INFORMATION  
STORAGE ADDRESS (TYPE 1)



1006669.127001

FIG.5

# SELECTION OF ADDRESS BASE FOR THE DEFECT TABLE INFORMATION STORAGE AREA

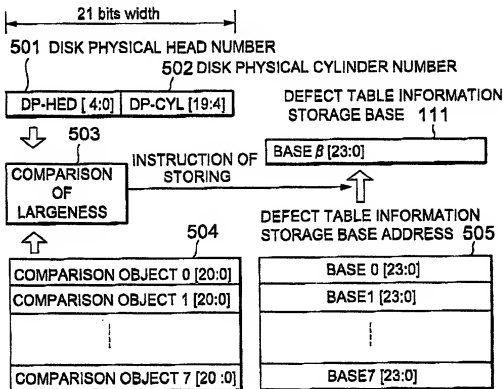


FIG.6

FORMAT OF DEFECT TABLE INFORMATION STORAGE AREA (TYPE 1)

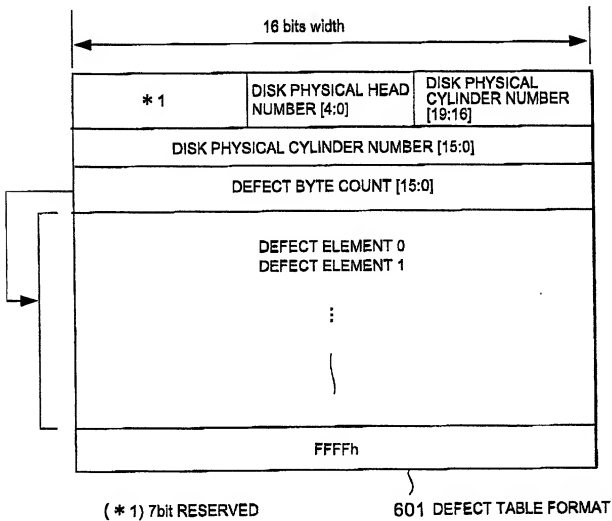


FIG. 7

## SECTOR ALLOCATION MAP INCLUDING DEFECTS

(IN THE CASE OF HEAD = 0,  
 TRACK  $m$  MEANS  
 CYLINDER NUMBER =  $m$   
 AND HEAD NUMBER = 0)

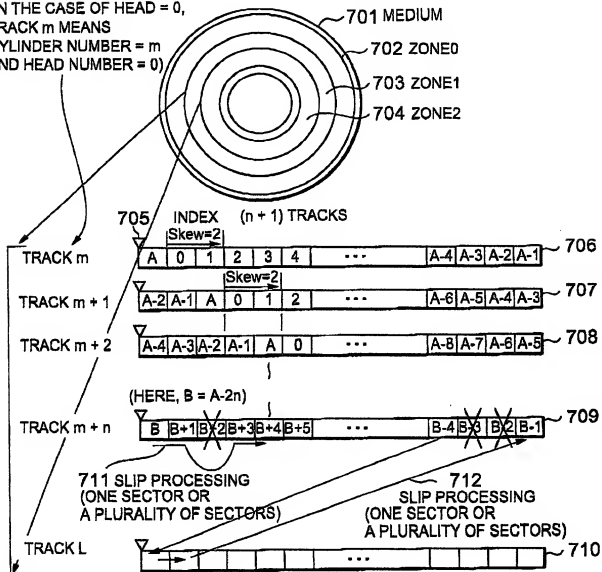


FIG.8

## INFORMATION REQUIRED FOR A DEFECT ELEMENT

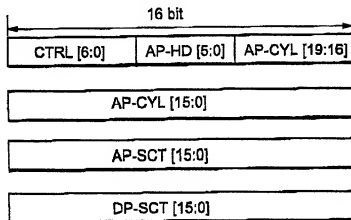
KIND OF DEFECT INFORMATION	CONTENTS
(1) SKIP INFORMATION	1) DISK PHYSICAL SECTOR NUMBER (DP-SCT [19:0]) AT WHICH A DEFECT EXISTS. 2) DISK PHYSICAL SECTOR NUMBER OF SUBSTITUTE (AP-CYL [19:0], AP- HED[4:0], AP-SCT [15:0 ]) 3) THE NUMBER OF SECTORS TO BE SKIPPED SUCCESSIVELY (DP-SCTCNT[15:0])
(2) SLIP INFORMATION	1) DISK PHYSICAL NUMBER (DP-SCT[15:0] AT WHICH A DEFECT EXISTS. : 2) THE NUMBER OF SECTORS TO BE SLIPPED SUCCESSIVELY (ADP- SECNUM[15:0])
(3) END SECTOR INFORMATION	1) END SECTOR NUMBER (DP-SCT[15:0]) OF THE TRACK CONCERNED WHEN THE END SECTOR IS UNUSABLE AS A DEFECTIVE SECTOR, THE USABLE END DISK PHYSICAL SECTOR NUMBER IN THE TRACK IS DESIGNATED

1006669-721031

FIG.9

## FORMAT OF DEFECT ELEMENT (FIRST)

## (1) SKIP OF ONE SECTOR (4 W)



## (2) SKIP OF SUCCESSIVE SECTORS (5 W)

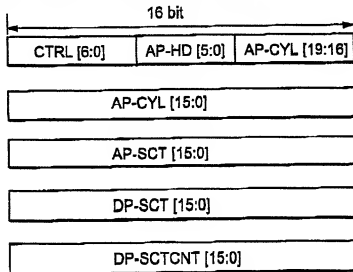
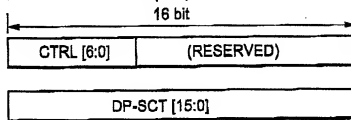


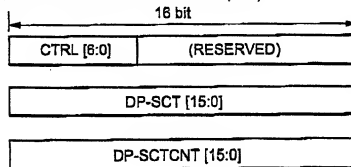
FIG.10

## FORMAT OF DEFECT ELEMENT (SECOND)

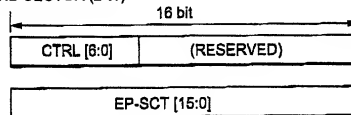
## (3) SLIP OF ONE SECTOR (2 W)



## (4) SLIP OF SUCCESSIVE SECTORS (3 W)



## (5) END SECTOR (2 W)



## (6) BOUNDARY OF THE DEFECT TABLE (1 W)

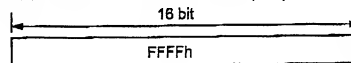
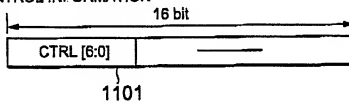


FIG.11

## FORMAT OF CONTROL INFORMATION

## (1) CONTROL INFORMATION



CTRL [6] : END OF SECTOR

1: END SECTOR NUMBER OF THE TRACK

CTRL [5] : SKIP/SLIP

INDICATION OF SKIP OR SLIP

1: SKIP, 0: SLIP

CTRL [4] : SEQUENTIAL

INDICATION OF SUCCESSIVE SECTORS PROCESSING

1: SUCCESSIVE SECTOR PROCESSING, 0: ONE SECTOR PROCESSING

CTRL [3] : SPARE ON TRACK

INDICATION IF A SUBSTITUTE OF THE DEFECTIVE SECTOR EXISTS  
ON THE CURRENT TRACK

1: CURRENT TRACK, 0: ANOTHER TRACK

CTRL [2] : (RESERVED)

CTRL [1] : (RESERVED)

CTRL [0] : (RESERVED)

FIG.12

CONFIGURATION OF ELECTRONIC CIRCUIT FOR DISK APPARATUS 1212

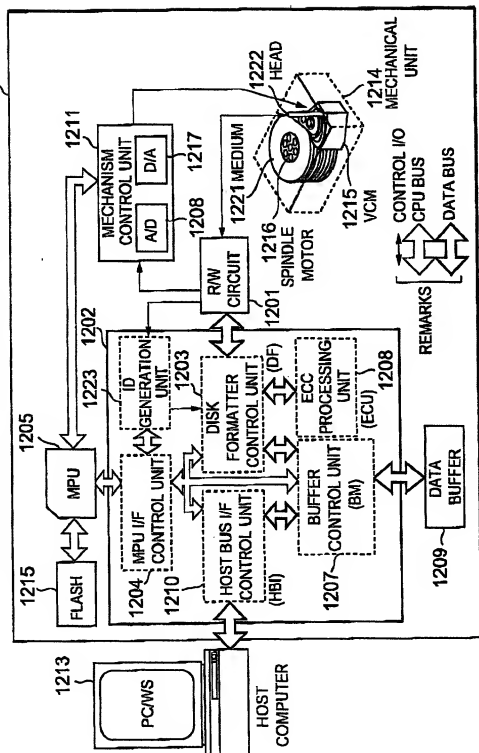
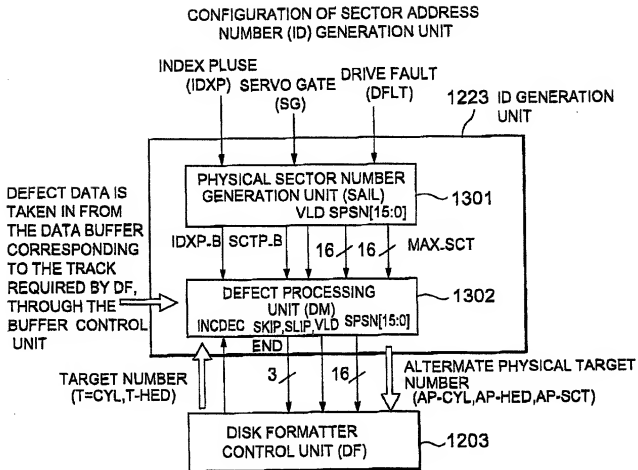


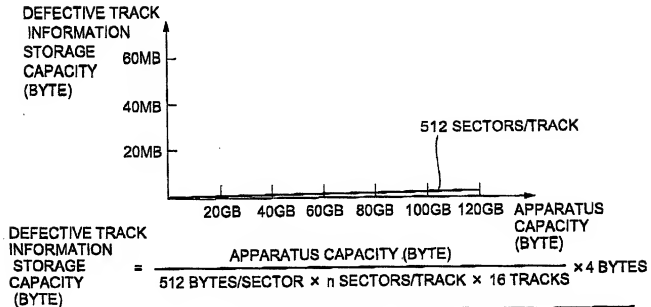
FIG.13



1005550-121004

FIG.14

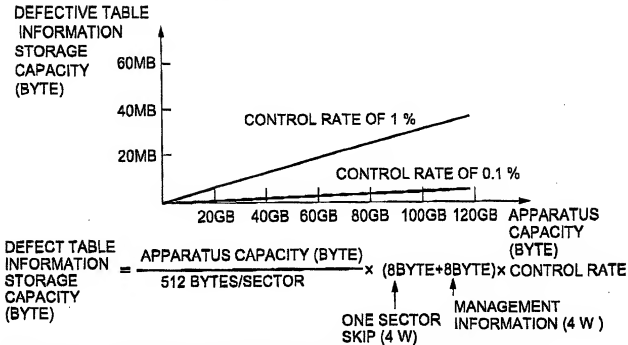
APPARATUS CAPACITY AND TRACK INFORMATION  
STORAGE CAPACITY(TYPE 1)



APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECTIVE TRACK INFORMATION STORAGE CAPACITY			
		SECTOR COUNT PER TRACK (n: SECTORS/TRK)			
		512	1024	2048	4096
20GB	39MSECTORS	19.1KB	9.5KB	4.8KB	2.4KB
40GB	78MSECTORS	38.1KB	19.1KB	9.5KB	4.8KB
60GB	117MSECTORS	57.2KB	28.6KB	14.3KB	7.2KB
80GB	156MSECTORS	76.3KB	38.1KB	19.1KB	9.5KB
100GB	195MSECTORS	95.4KB	47.7KB	23.8KB	11.9KB
120GB	234MSECTORS	114KB	57.2KB	28.6KB	14.3KB

FIG.15

APPARATUS CAPACITY AND DEFECT TABLE  
INFORMATION STORAGE CAPACITY (TYPE1)



CONTROL RATE = CONTROLLED NUMBER OF DEFECTIVE SECTORS / NUMBER  
OF ALL SECTORS IN APPARATUS

(a) CONTROL RATE OF 0.1 %

APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39MSECTORS	39 K DEFECTIVE SECTORS (825 KB)
40GB	78MSECTORS	78 K DEFECTIVE SECTORS (1.3MB)
60GB	117MSECTORS	117K DEFECTIVE SECTORS (1.9MB)
80GB	156MSECTORS	156K DEFECTIVE SECTORS (2.5MB)
100GB	195MSECTORS	195K DEFECTIVE SECTORS (3.1MB)
120GB	234MSECTORS	234K DEFECTIVE SECTORS (3.8MB)

(b) CONTROL RATE OF 1%

APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39MSECTORS	390 K DEFECTIVE SECTORS (6.3MB)
40GB	78MSECTORS	780 K DEFECTIVE SECTORS (13MB)
60GB	117MSECTORS	1.2M DEFECTIVE SECTORS (19MB)
80GB	156MSECTORS	1.6M DEFECTIVE SECTORS (25MB)
100GB	195MSECTORS	2.0M DEFECTIVE SECTORS (31MB)
120GB	234MSECTORS	2.3M DEFECTIVE SECTORS (38MB)

FIG.16

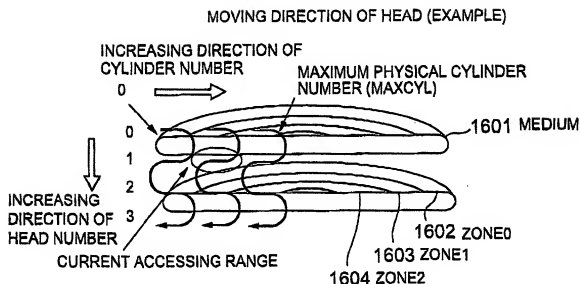


FIG.17

RELATION BETWEEN MOVING DIRECTION OF HEAD,  
CYLINDER AND HEAD (EXAMPLE)

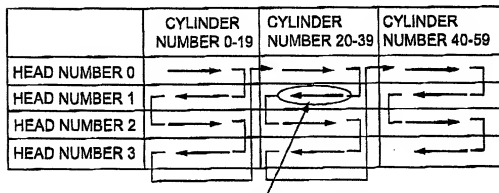


FIG.18

FORMAT OF DEFECT TABLE INFORMATION  
STORAGE AREA (TYPE2)

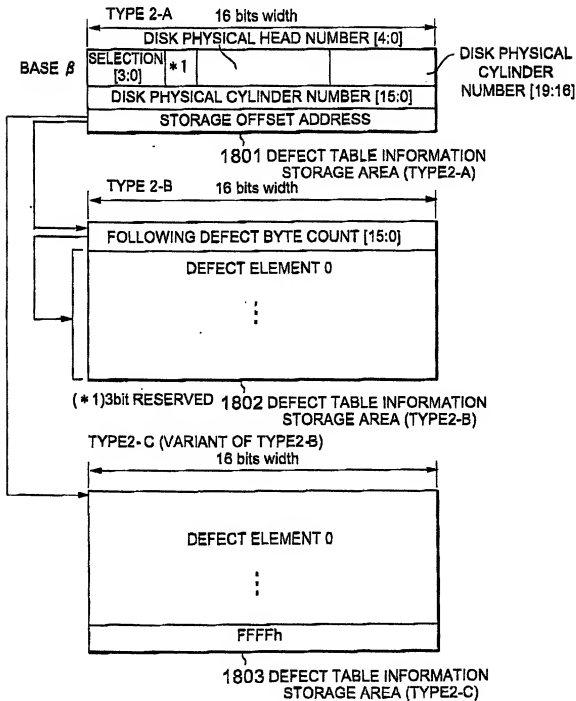
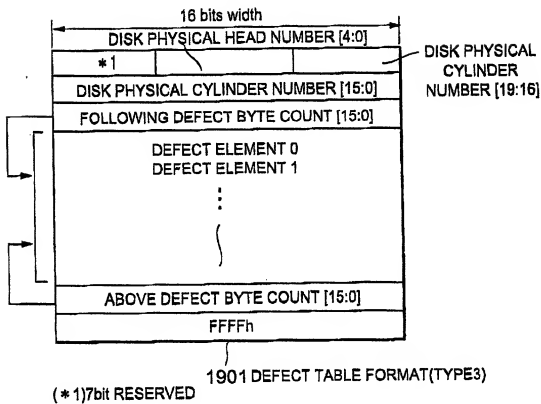


FIG.19

FORMAT OF DEFECT TABLE INFORMATION  
STORAGE AREA (TYPE3)



10000000.721001

FIG.20

COMPARISON OBJECT 504

DEFECT TABLE BASE  
ADDRESS 505

TRACK NUMBER 0-100	1000H
TRACK NUMBER 101-500	5000H
TRACK NUMBER 501-800	8000H
...	...

10000000.121001

FIG.21

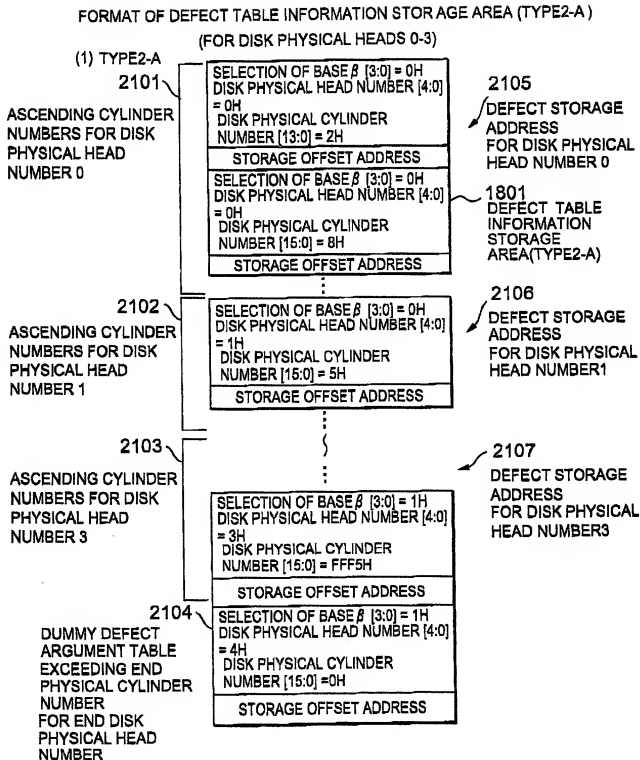


FIG.22

FORMAT OF DEFECT TABLE INFORMATION STORAGE AREA (TYPE2-B)  
(FOR DISK PHYSICAL HEADS 0-3)

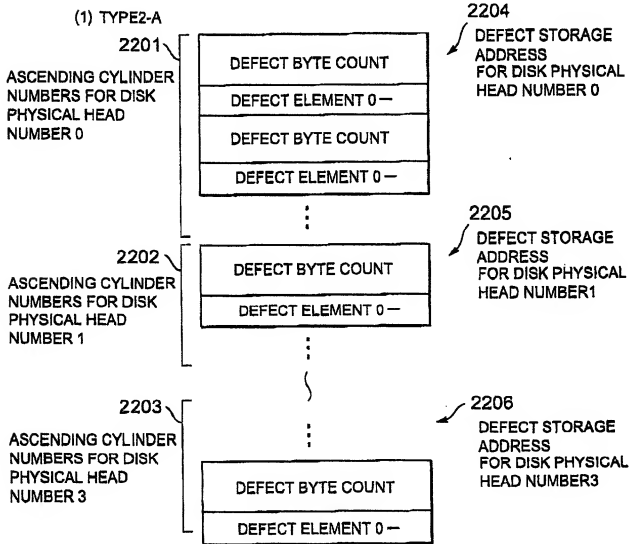
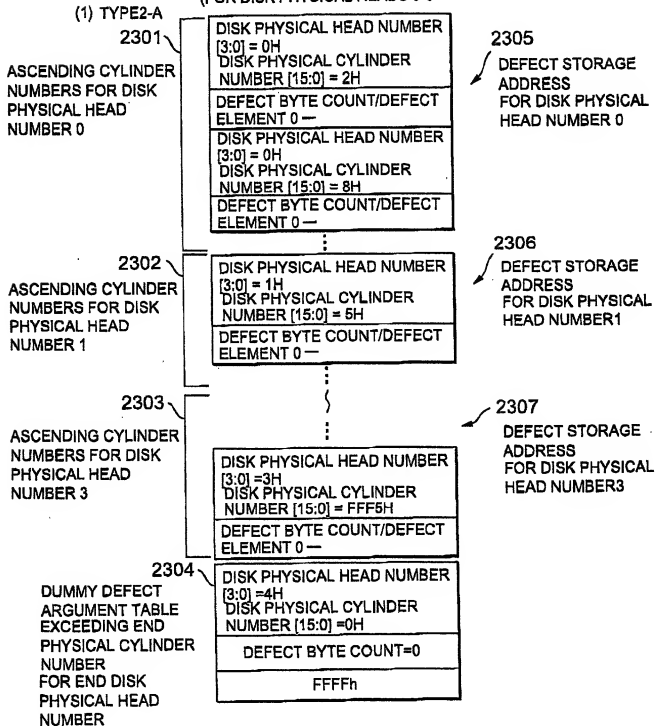


FIG.23

## FORMAT OF DEFECT TABLE INFORMATION STORAGE AREA (TYPE3)

(FOR DISK PHYSICAL HEADS 0-3

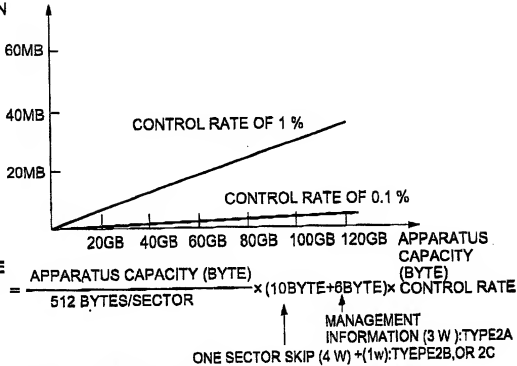


1006660.721001

FIG.24

APPARATUS CAPACITY AND DEFECT TABLE  
INFORMATION STORAGE CAPACITY (TYPE2)

DEFECT TABLE  
INFORMATION  
STORAGE  
CAPACITY  
(BYTE)



CONTROL RATE = CONTROLLED NUMBER OF DEFECTIVE SECTORS / NUMBER OF ALL SECTORS IN APPARATUS

(a) CONTROL RATE OF 0.1 %

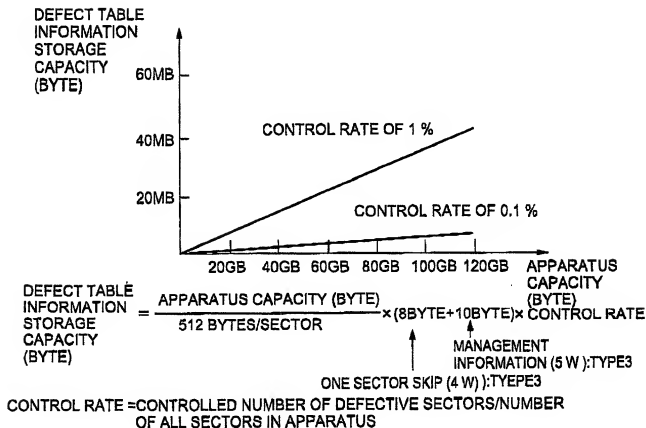
APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39M SECTORS	39 K DEFECTIVE SECTORS (625KB)
40GB	78M SECTORS	78 K DEFECTIVE SECTORS (1.3MB)
60GB	117M SECTORS	117K DEFECTIVE SECTORS (1.9MB)
80GB	156M SECTORS	156K DEFECTIVE SECTORS (2.5MB)
100GB	195M SECTORS	195K DEFECTIVE SECTORS (3.1MB)
120GB	234M SECTORS	234K DEFECTIVE SECTORS (3.8MB)

(b) CONTROL RATE OF 1%

APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39M SECTORS	390 K DEFECTIVE SECTORS (6.3MB)
40GB	78M SECTORS	780 K DEFECTIVE SECTORS (13MB)
60GB	117M SECTORS	1.2M DEFECTIVE SECTORS (19MB)
80GB	156M SECTORS	1.6M DEFECTIVE SECTORS (25MB)
100GB	195M SECTORS	2.0M DEFECTIVE SECTORS (31MB)
120GB	234M SECTORS	2.3M DEFECTIVE SECTORS (38MB)

FIG.25

APPARATUS CAPACITY AND DEFECT TABLE  
INFORMATION STORAGE CAPACITY (TYPE3)



## (a) CONTROL RATE OF 0.1 %

APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39M SECTORS	39 K DEFECTIVE SECTORS (700KB)
40GB	78M SECTORS	78 K DEFECTIVE SECTORS (1.4MB)
60GB	117M SECTORS	117K DEFECTIVE SECTORS (2.1MB)
80GB	156M SECTORS	156K DEFECTIVE SECTORS (2.8MB)
100GB	195M SECTORS	195K DEFECTIVE SECTORS (3.5MB)
120GB	234M SECTORS	234K DEFECTIVE SECTORS (4.2MB)

## (b) CONTROL RATE OF 1%

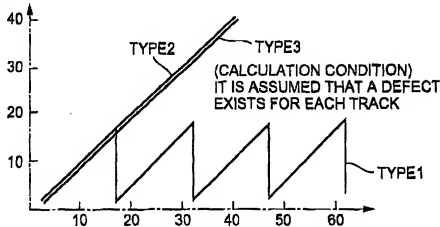
APPARATUS CAPACITY	TOTAL SECTOR COUNT	DEFECT TABLE INFORMATION STORAGE CAPACITY
20GB	39M SECTORS	390 K DEFECTIVE SECTORS (7MB)
40GB	78M SECTORS	780 K DEFECTIVE SECTORS (14MB)
60GB	117M SECTORS	1.2M DEFECTIVE SECTORS (21MB)
80GB	156M SECTORS	1.6M DEFECTIVE SECTORS (28MB)
100GB	195M SECTORS	2.0M DEFECTIVE SECTORS (35MB)
120GB	234M SECTORS	2.3M DEFECTIVE SECTORS (42MB)

1000550-727001

FIG.26

COMPARISON OF NUMBERS OF TIMES OF ACCESSING BUFFER  
REQUIRED UNTIL REACHING TARGET DEFECTIVE TRACK

NUMBER OF TIMES OF  
ACCESSING BUFFER  
UNTIL REACHING  
DEFECTIVE TRACK



PLACE OF THE DEFECT  
IN THE SEQUENCE OF  
STORAGE

- CASE OF TYPE1  
(PROCEDURE 1) ACCESS TO DEFECTIVE TRACK INFORMATION STORAGE AREA  
(PROCEDURE 2) ACCESS TO TOP OF DEFECT TABLE INFORMATION STORAGE AREA  
(PROCEDURE 3) ACCESS TO DEFECT TABLE INFORMATION STORAGE AREA  
(2ND THROUGH 16TH AT MAXIMUM; IN THE SEQUENCE OF STORAGE)
- CASE OF TYPE2  
(PROCEDURE 1) ACCESS TO DEFECTIVE TRACK INFORMATION STORAGE AREA  
(IN ORDER OF STORAGE)  
(PROCEDURE 2) ACCESS TO DEFECT TABLE INFORMATION
- CASE OF TYPE3  
(PROCEDURE 1) ACCESS TO DEFECTIVE TRACK INFORMATION STORAGE AREA  
(IN ORDER OF STORAGE)

TABLE DEFECTIVE TRACK STORAGE NUMBER AND THE NUMBER  
OF TIMES OF ACCESSING THE BUFFER

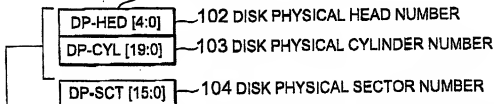
PLACE OF THE DEFECTIVE TRACK IN THE SEQUENCE OF STORAGE	NUMBER OF TIMES OF ACCESSING THE BUFFER		
	TYPE1	TYPE2	TYPE3
1	2	2	1
2	3	3	2
3	4	4	3
...			
16	17	17	16
17	2	18	17
18	3	19	18
...			
n	RESIDUE (n/16)		
	+1	n+1	n

FIG.27

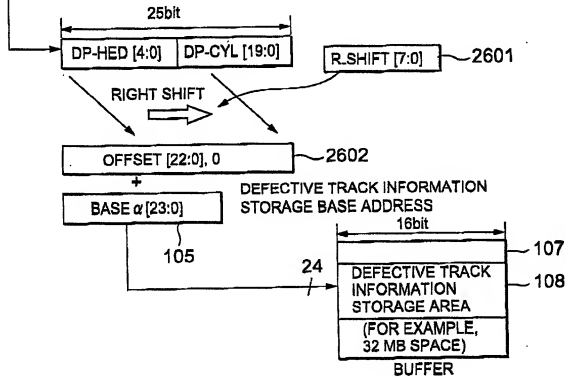
METHOD OF GENERATING OFFSET ADDRESS  
FOR DEFECTIVE TRACK INFORMATION (FIRST)

(STEP 1) MPU DESIGNATES A TARGET ADDRESS TO DF.

101 DISK PHYSICAL CHS NUMBER



(STEP 2) DM USES THIS TARGET ADDRESS TO LOAD THE DEFECT INFORMATION  
ON THE TRACK IN QUESTION.  
DM USES THIS NUMBER TO LOAD THE DEFECT INFORMATION FROM THE DEFECT  
STORAGE ADDRESS (ADDRESS SHOWN BELOW) IN THE BUFFER.



1006669-121001

FIG.28

METHOD OF GENERATING OFFSET ADDRESS  
FOR DEFECTIVE TRACK INFORMATION (SECOND)

(STEP 1) MPU DESIGNATES A TARGET ADDRESS TO DF.

101 DISK PHYSICAL CHS NUMBER

DP-HED [4:0] 102 DISK PHYSICAL HEAD NUMBER

DP-CYL [19:0] 103 DISK PHYSICAL CYLINDER NUMBER

DP-SCT [15:0] 104 DISK PHYSICAL SECTOR NUMBER

(STEP 2) DM USES THIS TARGET ADDRESS TO LOAD THE DEFECT INFORMATION  
ON THE TRACK IN QUESTION.  
DM USES THIS NUMBER TO LOAD THE DEFECT INFORMATION FROM THE DEFECT  
STORAGE ADDRESS (ADDRESS SHOWN BELOW) IN THE BUFFER.

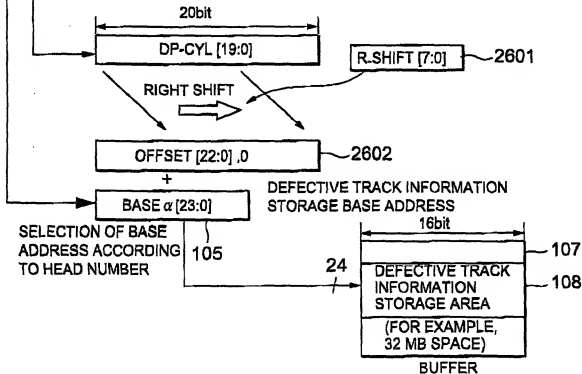


FIG.29

EXAMPLE OF FORMAT OF DEFECTIVE TRACK INFORMATION  
FOR TRACKS (TYPE 4)

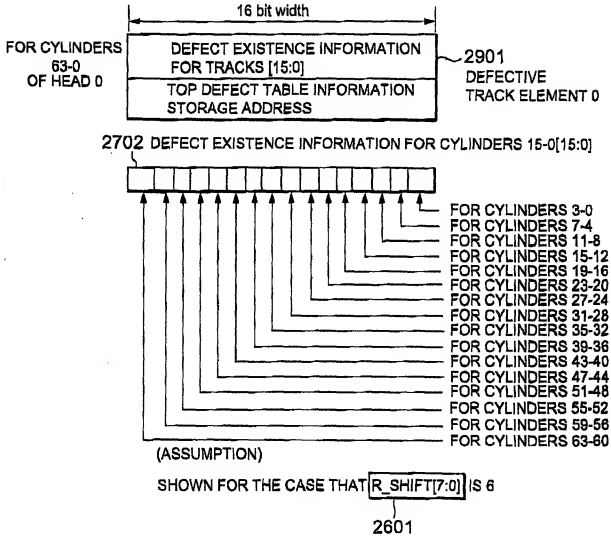
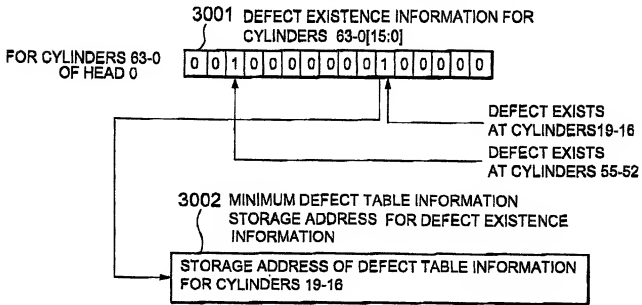


FIG.30

EXAMPLE OF FORMAT OF DEFECTIVE TRACK INFORMATION  
STORAGE ADDRESS FOR TRACKS (TYPE4)



10006659.121001

FIG.31

## COMPARISON OF SYSTEMS

SYSTEM	TYPE 1	TYPE 2	TYPE 3	TYPE 4
	WHOLE TRACK INFORMATION STORING	DEFECT TABLE INFORMATION STORING	DEFECT TABLE INFORMATION STORING	WHOLE TRACK INFORMATION COMPRESSING AND STORING
DEFECTIVE TRACK INFORMATION	ALL TRACKS	----	----	COMPRESSED AND FOR ALL TRACKS
DEFECT TABLE INFORMATION	DEFECTIVE TRACKS ONLY	DEFECTIVE TRACKS ONLY	SEARCHABLE FORWARD AND BACKWARD DEFECTIVE TRACKS	DEFECTIVE TRACKS ONLY
DEFECTIVE TRACK INFORMATION CAPACITY	$\alpha$	----	----	$\alpha/2(R+4)$
DEFECT TABLE INFORMATION CAPACITY	$\beta$	$1.1\beta$	$1.1\beta$	$\beta$
NECESSITY OF PUTTING DEFECT TABLES IN ORDER OF ADDRESS	YES	----	----	YES
NECESSITY OF PUTTING DEFECT TABLES IN ORDER OF ADDRESS	NO	YES	YES	NO
NECESSITY FOR FW TO KNOW STORAGE ADDRESS	YES	YES	NO	YES
NUMBER OF TIMES OF ACCESSING BUFFER UNTIL REACHING TARGET DEFECT TABLE	2 - 17	$n + 1$	$n$	$2 - 2(R+4)+1$

(1) R IS RIGHT SHIFT AMOUNT

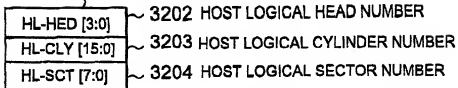
(2) n IS PLACE OF DEFECT IN SEQUENCE OF STORAGE, COUNTING FROM THE SMALLEST ADDRESS

(3)  $\alpha$  AND  $\beta$  ARE A CONSTANT FOR COMPARISON OF CAPACITY RATIO (BYTE COUNT) OF EACH TYPE

FIG.32

CONVERSION FROM HOST LOGICAL NUMBER  
TO DISK PHYSICAL NUMBER

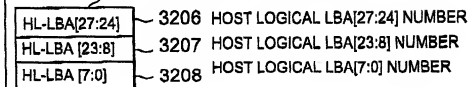
3201 HOST LOGICAL CHS NUMBER



OR



3205 HOST LOGICAL LBA NUMBER



3209 DISK PHYSICAL CHS NUMBER

